Silver release from nano-silver containing plastic food containers

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Silver release from nano-silver containing plastic food containers

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Sustainable Nanotechnologies Project

Introduction / Materials & Methods

The potential migration of AgNP into food and during washing, scrubbing, etc. has been poorly addressed; however, it is essential for the purpose of human and environmental exposure assessment.

Experimental setup:

Migration assay was set up following European Commission Directive 97/48/EC for articles intended to be in contact with food.

Four brands of commercially available plastic food containers were incubated for 10 days at 40ºC with three different food simulants: Milli-Q water, 10% ethanol, and 3% acetic acid.

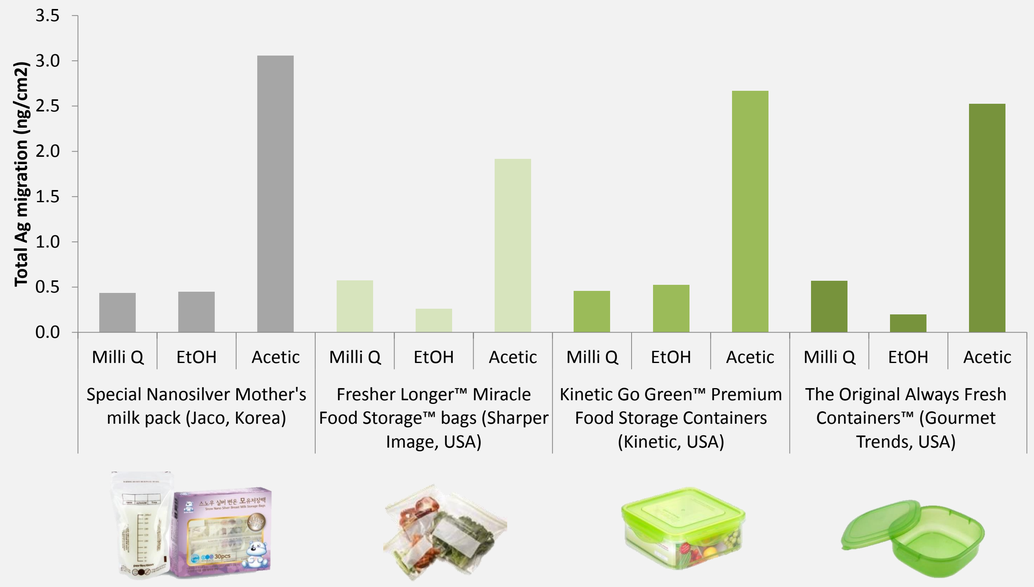
Analysis:

The total amount of silver in plastic containers (day 0) and migration solutions (day 10) was quantified by ICP-MS analysis.

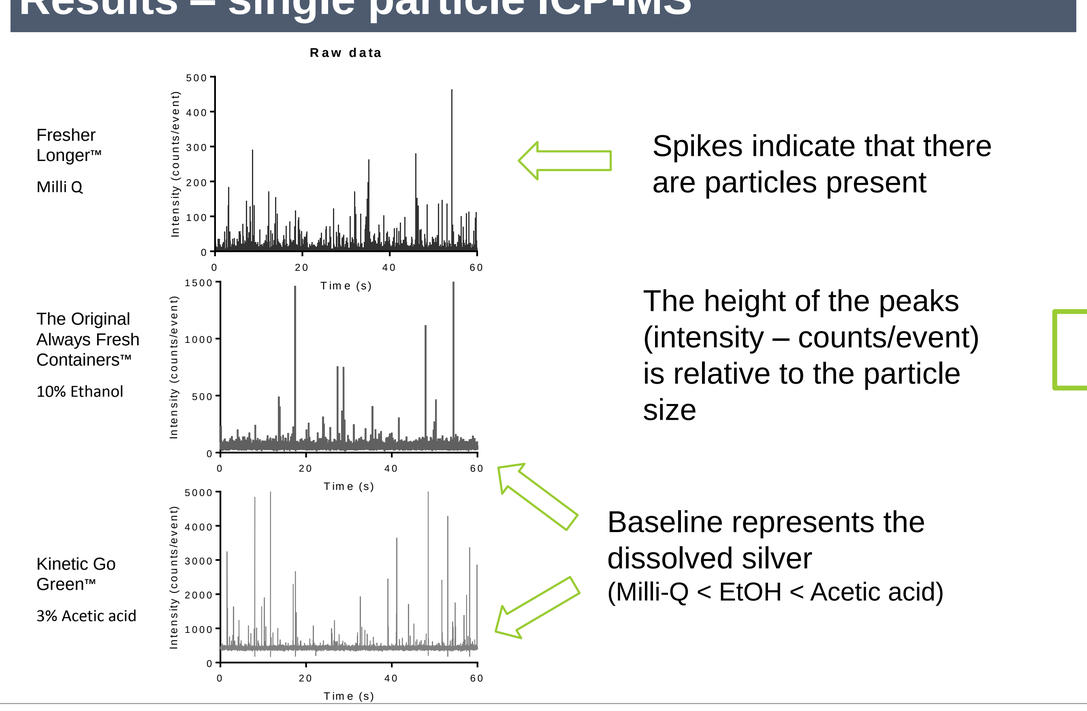
The size of the migrated particles was investigated by

- single particle ICP-MS (Agilent 7700x)
- TEM-EDS imaging (FEI Tecnai G2)

Results – total silver migration



Results – single particle ICP-MS



Spikes indicate that there are particles present

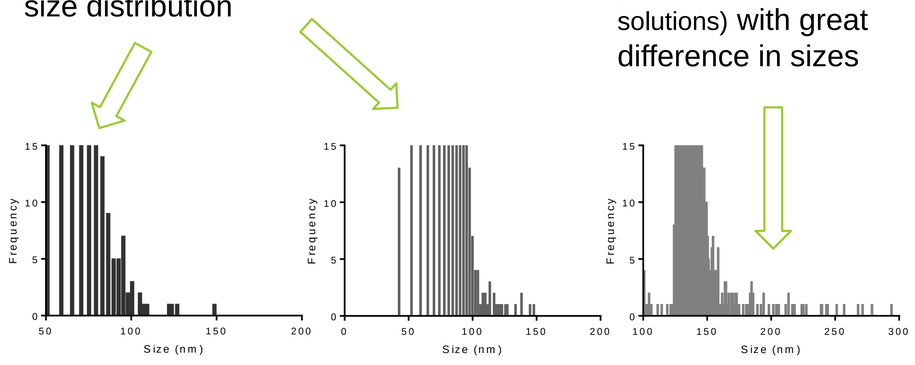
The height of the peaks (intensity – counts/event) is relative to the particle size

Baseline represents the dissolved silver
(Milli-Q < EtOH < Acetic acid)

Results – single particle ICP-MS

Due to the dissolved silver the background peak is really broad making it difficult to obtain a good size distribution

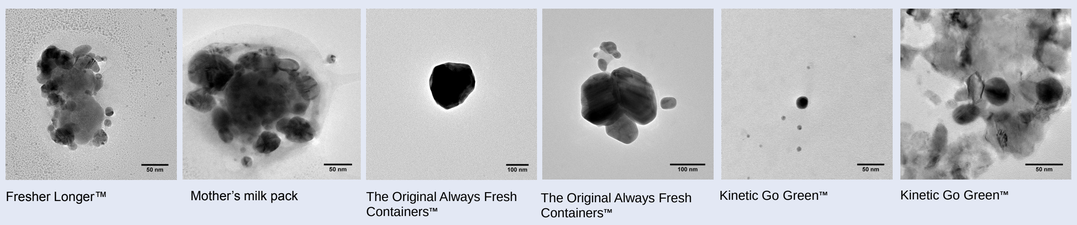
Samples had very few particles (too dilute solutions) with great difference in sizes



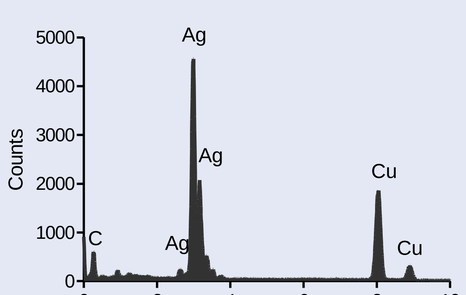
Fresher Longer™, Milli Q | The Original Always Fresh Containers™, EtOH | Kinetic Go Green™, Acetic acid

Y axis truncated at 15 for size distribution graphs. Bin size = 10.
Background and size distribution calculations performed as described by Pace et al. (2011) *Analytical chemistry* 83.24: 9361-9369.

Results – TEM-EDS



Fresher Longer™ | Mother's milk pack | The Original Always Fresh Containers™ | The Original Always Fresh Containers™ | Kinetic Go Green™ | Kinetic Go Green™



EDS sepctrum from The Original Always Fresh Containers™ sample

TEM Images obtained from migration solution samples after 10 days in 3% acetic acid

- EDS spectra confirmed that particles found consisted of Ag
- Both dispersed and agglomerated particles were observed
- AgNP sizes were ranging from around 20 nm to more than 200 nm

Discussion / Conclusions

- Highest migration of total silver was observed in acetic acid for all four brands
- Single particle ICP-MS results showed that in acetic acid there was more dissolved silver found than particulate silver
- The presence of AgNP was confirmed by TEM-EDS analysis for all acetic acid samples
- The brand with highest release of Ag (ng/cm^2) was Special Nanosilver Mother's milk pack from Jaco, Korea
- The highest content of Ag (per cm2) was measured for The Original Always Fresh Containers™

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